Title: **Joining Ion Transport Materials Using a Novel Transient Liquid Phase Method**

Author: Darryl P. Butt
Boise State University
1910 University Dr.
Boise, ID 83725
208-426-1054
208-426-2470 (Fax)
darrylbutt@boisestate.edu
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Abstract:

Joining is an enabling technology for many ceramics applications. Often ceramics are only useful in a system of components, requiring that they be bonded in some fashion to other ceramic components of the same composition or dissimilar materials such as metals or other ceramics. This is a particularly true in the practical applications of fuel cells, gas separation membranes, and sensors, where a wide variety of ceramic-ceramic and ceramic-metal joints are required.

There are a variety of existing methods for joining ceramics to themselves or other materials. For example, brazes and glasses are commonly used. These joining methods have the disadvantage of leaving behind an interfacial phase with thermal and physical properties inferior to that of the materials being joined. For example, brazes leave behind a ductile metal, which at elevated temperatures can creep, may be incompatible with the surrounding materials, or may oxidize. Similarly, glass seals may have significantly different thermal expansion coefficients compared with surrounding materials resulting in undesirable residual stresses, will soften and creep at temperatures above their respective glass transition temperature, and can be chemically incompatible at elevated temperatures.

Consequently, industry and academia have sought for many years to develop joining methods which leave behind effectively no interfacial phase, or a compatible, refractory phase with virtually the same thermal expansion coefficient as the joined parts. This proposed method accomplishes that goal through a novel, TLP approach. We emphasize here that the PI has already conducted a feasibility demonstration of the proposed technology. The technology is highly novel and no comparable methods have been developed or reported in the literature. In this presentation we describe a novel method for joining specific perovskite membranes using TLP inks and tapes. It is shown that materials can be joined with excellent hermeticity and mechanical properties. The focus of our research has been on the $La_xCa_yFeO_{3-z}$ perovskite. However, we will discuss a variety of systems where the approach can be used.

Students Supported: Patrick Callahan, M.S. student, Boise State University